The Burden of Choice: The Liability of Peer Performance Information in Situations of Abundant Choice

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Abstract
Decision makers often turn to peer performance information, i.e. information on peers’ outcomes of the choices made, not the choices per se, to reduce uncertainty about the outcome of strategic decisions. In this paper, we investigate the impact of such information on search behavior and efficacy. Using a series of online experiments, we find that, while beneficial in situations of limited choice, peer performance information may even impede the efficacy of search efforts for scenarios of abundant choice. For limited choice, we propose and find, that peer performance information informs decision makers on the search space and thus, helps them avoid searching too much or too little. Meanwhile, for abundant choice, peer performance information has no such benefits and for certain cases even causes decision makers to be worse off by triggering over-exploration. This research contributes to research on the Behavioral Theory of the Firm and provides evidence that could inform managers on how to employ peer performance information.
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ABSTRACT

Decision makers often turn to peer performance information, i.e. information on peers’ outcomes of the choices made, not the choices per se, to reduce uncertainty about the outcome of strategic decisions. In this paper, we investigate the impact of such information on search behavior and efficacy. Using a series of online experiments, we find that, while beneficial in situations of limited choice, peer performance information may even impede the efficacy of search efforts for scenarios of abundant choice. For limited choice, we propose and find, that peer performance information informs decision makers on the search space and thus, helps them avoid searching too much or too little. Meanwhile, for abundant choice, peer performance information has no such benefits and for certain cases even causes decision makers to be worse of by triggering over-exploration. This research contributes to research on the Behavioral Theory of the Firm and provides evidence that could inform managers on how to employ peer performance information.

Keywords:
Peer performance information; organizational learning, exploration / exploitation
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INTRODUCTION

"When you look at what Mercedes is doing, it's overwhelming, but it also shows us what is possible."
Kamui Kobayashi, Caterham Formula 1 driver

It is difficult to imagine organizational tasks without peer performance information, i.e., information about the outcome of peers performing the same tasks. Being able to compare your own performance with your peer’s performance provides essential information to put one’s own performance into perspective (Festinger, 1954), and is thus important in decision making. Take, for example, Kamui Kobayashi from our opening quote: Peer performance information (about Mercedes’ performance) allows him to put not only his own performance into perspective (“Mercedes is faster than us”) but also provides him with an idea how much is lagging behind his peers (“If we did as good as Mercedes, we can improve another X seconds per lap”).

Similarly, the performance of decision makers and firms is often compared to their peers’ (Cyert & March, 1963; Elsbach & Kramer, 1996; Rowley, Shipilov, & Greve, 2017). For example, (future) entrepreneurs observe entrepreneurial activities of their peers before entering a market (Kacperczyk, 2012). While such (peer) performance information is ubiquitous in many (inter- and intra) organizational settings, the implications are less clear. Is peer performance information valuable? Specifically, does it improve the efficacy of search and decision making? Do, for example, entrepreneurs make better initial strategic choices if they
know how their peers performed? Or, on a more abstract level, are there benefits to social comparison?

Previous studies have demonstrated the strong motivational effects of peer performance information (e.g. Flynn & Amanatullah, 2012). First, they have found peer performance information to motivate greater task effort, i.e. decision makers driven by the desire to reduce negative discrepancies to their peers work harder at the same task (Festinger, 1954; Locke & Latham, 2002). Second, peer performance information motivates a greater focus onto a common goal, i.e. leads decision makers to ignore other task to concentrate their efforts on the focal task (Fliegenbaum, Hart, & Schendel, 1996; Locke & Latham, 2002). Third, the performance relative to one’s peers determines the choice of reference points, i.e. which peer’s performance or historical own performance level the focal actor chooses to make his performance target (Falk & Knell, 2004; Gneezy, Niederle, & Rustichini, 2003; Moliterno, Beck, Beckman, & Meyer, 2014). Overall, social comparison increases task motivation by triggering an intrinsic status seeking behavior of decision makers in need for enhancing their status by outperforming similar others (Huberman, Loch, & Öncüler, 2004; Robson, 1992; Zizzo, 2002). In our study, we intentionally exclude any possibilities for these motivational or status seeking effects as there is no live competition between actors. We here focus fully on the informational aspect of peer performance information: Does the availability of peer performance information results in better choices (as opposed to greater effort)?

We study this question in an experiment using a simple search and learning task. While extant research often (more or less explicitly) assumes that peer performance information (or social comparison) has a positive effect on decision making (Cyert & March, 1963; Locke &
Latham, 1990; Smith, Locke, & Barry, 1990), our experimental study points to settings in which the availability of peer performance information may even have a negative on the efficacy of search and decision making, i.e., results in inferior choices compared to settings in which peer performance information is absent. Specifically, we find that in settings in which decision makers can choose among a multitude of different alternatives, availability of peer performance information may lead to inferior choices. Only if the number of alternatives is small, peer performance information can improve search and decision making.

Contexts where choice is abundant have gained significance of late. Firms operate less in local and increasingly in global markets (Levitt, 1983). Thereby, firms have more potential markets to invest in than they previously had in a localized economy (Porter, 1986). Scholars have also maintained that decision makers find themselves more and more in situations of hypercompetition that forces them to consider a broader set of alternative strategic choices for example in terms of pricing strategies (Craig, 1996). Lastly, managers of small business have been found to consider a wider range of strategies as they mature and adopt more formalized decision processes (Lyles, Baird, Orris, & Kuratko, 1993). And also the aforementioned entrepreneurs often face substantial environmental uncertainty through a complex and dynamic environment featuring a multitude of strategic alternatives (Packard, Clark, & Klein, 2017).

We also investigate the implications of different types of peer performance information and find that their implications vary across these settings. For example, while information about the performance of the best peer is particularly valuable for narrow choice sets, it can become a liability for broad choice sets. However, information about the average performance of peers is always valuable, never becoming a liability, even with large choice sets. Yet, we also find that
in our experiment, participants often fail to appropriate the entire (theoretical) value embodied in peer performance information. Finally, we find that – in contrast to many theoretical arguments, peer performance information can improve performance because it suppresses, rather than induces, search and exploration.

These findings have important implications for performance feedback theory (Baum & Dahlin, 2007; Cyert & March, 1963; Greve, 1998). An implicit assumption in this literature has been that peer performance information triggers search and that increased search efforts, in turn, yield higher levels of performance (Benner & Tushman, 2002; 2003; Lewin, Long, & Carroll, 1999). However, it remains puzzling that in practice a better performance often seems to be the consequence of just the right amount of search as opposed to just more search (Uotila et al., 2009). In adding the perspective of search space, i.e. how peer performance informs decision makers on when and how long to search, we contend that both of the aforementioned implicit assumptions do not generally hold true. We instead maintain that peer performance information can lead to performance improvements particularly when it suppresses search while it leads to performance decrease when triggering excessive search efforts. Thus, we also challenge the assumption that the provision of peer performance information always improves own performance (Cappelli & Tavis, 2016; Goler, Gale, & Grant, 2016; Hope & Fraser, 2003; Locke & Latham, 1990; Smith, Locke, & Barry, 1990).

Further, we follow the call for explicit research on the consequences of different types of social aspirations, i.e. peer performance information about the average versus the best peer’s performance among others (Shinkle, 2012). Prior studies have often made no difference in the assumed consequences of different types of peer performance information (Cyert & March,
We show that the performance consequences are distinct for each type of peer performance information. Also, we maintain that the risks of providing peer performance information are also distinctly different for different type of peer performance information. Specifically, the threat of too much search seems to be unique to the best peer's performance information.

Finally, a threat of adding more options has been discussed in prior research. Those studies have identified different reasons for why individuals make worse decisions when facing a multitude of options. First, they have found that adding irrelevant new alternatives changes how decision makers evaluate their old options (Ariely, 2008). Secondly, having a large number of alternatives has been found to cause an information overload, i.e. create a situation where decision makers cannot process information on all the available alternatives any longer (Hauser & Wernerfelt, 1990). Lastly, scholars have observed a paralysing effect of too much choice (Iyengar & Lepper, 2000). We show, however, that having more options in a search task leads to worse performance as a consequence of over-exploration. In particular, we demonstrate how best peer’s performance information causes decision makers to keep searching for a maximum they know must exist while at the same time being unable to see the low likelihood of actually finding this maximum.

THEORY

Peer Performance Information in Organizations

Information of how peers perform is prevalent across different levels of organizational contexts. At the individual level, employees within organizations are made aware of, and paid relative to
the performance of their peers (Elsbach & Kramer, 1996; Simons, 2000). Within the same organization, peer performance information is the basis of comparisons between business units (Aranda, Arellano, & Davila, 2014, 2017). When organizations are compared with other organizations, peer performance information is consequential for a wide range of organizational behaviors such as organizational search or risk taking (Baum & Dahlin, 2007; Cyert & March, 1963; Greve, 1998): The performance of comparable peer units (social aspirations) enters into the formulation of a performance target against which the focal unit’s performance will be evaluated (Cyert & March, 1963; Matsumura & Shin, 2006; Murphy, 2000). To this end, peer units performing similar tasks, in similar environments, are selected for comparison (Albuquerque, 2009; Haunschild & Miner, 1997).

Organizational decision makers use different standards of comparison to evaluate their performance against their peer units’ performance (Fliegenbaum et al., 1996). For example, while some research has shown that top managers benchmark against market share (Greve, 1998), others have maintained that an organization’s returns relative to the stock market is more commonly used (Hill & Hansen, 1991; Woo, Willard, & Daellenbach, 1992). In much of the strategy literature, industry average performance is the most common reference point (e.g., Bromiley, 1991; Fliegenbaum & Thomas, 1990; Lant, Milliken, & Batra, 1992), which reflects the assumption that a single external measure of comparison (e.g., firm ROA relative to industry ROA) is used by managers to evaluate whether the performance of their firm is satisfactory (above the industry average) or unsatisfactory (below the average). However, decision makers also pay attention to the worst and best performing peer unit. Information on the best peer performance is used when comparing oneself to best-in-class-performers (Frasier-Sleyman,
1992). This type of information is often provided as a stretch goal, i.e. a goal that is particularly difficult to reach (Kerr & Landauer, 2004) whereas the worst peer performance information is provided in the context of learning from failure (Maslach, Oana, Rerup, & Zbaracki, 2018).

**Implications of Peer Performance Information**

The provision of peer performance information has various behavioral and performance implications. First, it *motivates* decision makers to increase their task *effort* (Locke & Latham, 1990; Latham & Yukl, 1975). In particular, goal setting theory states that peer performance information motivates hard work and increased focus on activities related to achieving the performance target at the expense of other available activities (Locke & Latham, 2002). In their Strategic Reference Point Theory, Fliegenbaum et al. (1996) also state that peer performance can serve as a reference point that unites task efforts onto a common goal. The choice of this common goal is itself subject to the relative standing of a focal actor to his peers (Falk & Knell, 2004; Gneezy, Niederle, & Rustichini, 2003; Moliterno, Beck, Beckman, & Meyer, 2014).

Motivational arguments are traceable to the motif of status-enhancement through achieving a better relative standing compared to one’s peers (Huberman, Loch, & Önçüler, 2004; Robson, 1992; Zizzo, 2002). The prerequisite for such motivational factors to be present, however, is competition between actors (Washington & Zajac, 2005) in which they can gain “new social and economic status” (Friedman & Savage, 1948, p. 299). In sum, motivational arguments suggest that peer performance information stimulates effort (*working harder*) and task effectiveness (*working on the right problems*) for reasons of enhanced social status. In picking the context of an individual learning task without social competition, considerations of task motivation are
deliberately excluded from this study to focus only on the value of peer performance information.


Overall, to close performance gaps to the target, decision makers have been found to engage in more risk taking (Fliegenbaum et al., 1996; Kapeczyk, Beckman, & Moliterno, 2015), innovation efforts (Fleming & Bromiley, 2003; Nohria & Gulati, 1996), and organizational change (Greve, 1998, 2003a). Specifically, decision makers engage in problemistic search, i.e., a performance below the performance target is taken as a symptom of a problem and search is initiated for the appropriate solution (Cyert & March, 1963; Greve, 2003a). As Greve (2003b: 696) contented, a performance shortfall relative to a performance target functions as a “master switch” that triggers search. Arguments for the provision of stretch goals are made in a similar vein, maintaining that goal setting motivates an increase in experimentation (Golovin, 1997; Hamel & Prahalad, 1993; Hu et al., 2011).

Second, peer performance information may also provide valuable information about the search space: Peer performance information can be seen as an approximation of the possible outcomes that are attainable to the focal decision maker (Chen, Takeuchi, & Shum, 2013). Thus, it gives those decision makers ways and means to determine whether their search efforts have already yielded an above average or even an optimal solution (Knudsen & Srikanth, 2014; Choi, Lévesque, & Sheperd, 2008). An argument akin to ours is implicit in situations of decision makers trying to learn from the failure of others by seeking information on worst peers’
performance. Specifically, they can observe when other firms exploit alternatives with low payoffs and try to avoid those alternatives. In this research, we argue for another way in which decision makers exploit peer performance information. In particular, we argue that, in trying to balance exploration and exploitation (March, 1991), peer performance information allows for inferences about the optimal stopping point for exploration (MacLeod & Pingle, 2005; Shapira & Venezia, 1981).

We examine how peer performance information affects optional stopping points in a search task. First, consider a situation without additional information. In this situation, the tradeoff that decision makers face is whether to exploit, and thereby earn a payoff at a known rate, or to explore, which offers an opportunity to learn about potentially better alternatives (March, 1991). There is a cost to both exploiting too much (under-exploration) and exploring too much (over-exploration). Under-exploration lets the decision maker exploit a potentially inferior alternative (Denrell & March, 2001; Levinthal & March, 1981; Rhee & Kim, 2014; Tushman & Reilly, 1996), while over-exploration ignores the opportunity cost of time lost from exploiting a sufficiently good alternative (Billinger, Stieglitz, & Schumacher, 2013).

Next, we turn to the optimal behavior in a task of exploration and exploitation. In a world of unchanging payoffs, it is always beneficial to explore different alternatives before exploiting one alternative. Exploration needs to precede exploitation to gather information on the payoffs of available alternatives (Haleblian & Finkelstein, 1999; Levinthal & March, 1993). This information from experiential learning is necessary to evaluate whether a chosen alternative is adequate compared to the whole set of available alternatives. One run of exploration followed by one run of exploitation is the best approach because of opportunity
costs that would otherwise arise, i.e. if learning would take place later in the task, there is
simply not enough time to exploit the gained information. The amount of required exploration
is a function of the number of alternatives, the total duration of the task, and the distribution of
payoffs (Uotila, Maula, Keil, & Zahra, 2009). The total payoff as a function of the optional
stopping point, however, always takes a similar form (Marino, Aversa, Mesquita, & Anand,
2015; Uotila et al., 2009): An inverted U-shape with a slightly longer right tail. Exploring more
alternatives initially yields a rapid increase in overall performance while exploring beyond the
optimal stopping point decreases the learning benefits disappear as opportunity costs rise.

This optimal stopping point changes when peer performance information is available.
Since the purpose of initial exploration is to gather information on the quality of the available
alternatives, this process can be cut short when information on this quality is available via peer
performance. Consider for instance the average peer performance information. Without such
knowledge a decision maker learns about the absolute value of initially explored alternatives
without knowing whether the alternative is above average, and could hence stop exploration.
Experiential learning increases the likelihood of knowing that the currently exploited alternative
has an above average value, but there is no certainty until the end of the task. This long learning
period is unnecessary if the average performance of all alternatives available is known from the
start. By this same logic, the worst performing peer does not provide a utilizable performance
target and therefore, there should be no such advantage of such peer performance information.
However, peer performance information stemming from the worst peer is expected to have
performance benefits for those decision makers who would have otherwise exploited only one
alternative from the start. Tales of over-exploitation are numerous across the organizational
learning literature. Wang and Li (2008) maintain that while every firm has a unique optimal level of search, more often than not firms don’t find that optimum. This has been ascribed to an inappropriate corporate governance structure (Sampson, 2004), decision makers that become too risk averse to secure their own employment (Amihud & Lev, 1981; Holmstrom, 1979; Holmstrom & Milgrom, 1987) or over-confidence in an initial solution (Staw, 1981). Early routines can also lead to over-exploitation from competence traps (Levitt and March 1988, Leonard-Barton, 1992) and initial solutions that seem good can inhibit further exploration (Rhee & Kim, 2015). In those situations of over-exploitation there is a value to peer performance information from the worst peer’s performance. By giving a negative example, it tells the focal firm to not get stuck on first alternative that would otherwise seem profitable. Hence, even though worst peer performance information is not beneficial in all situations, we do expect it to be beneficial for a sub-sample of the population, namely those that otherwise would have had their mind set on over-exploitation.

Thus, we propose

_Hypothesis 1a. Peer performance information from the average performance of peers improves performance,
_Hypothesis 1b. Peer performance information from the best peer performance improves performance.
_Hypothesis 1c. Peer performance information from the worst peer’s performance does improve performance but to a lesser extent than the other two types of peer performance information as only a sub-sample of the population benefits from it._
Prior research has, however, found that learning benefits such as the above proposed are affected by the number of available alternatives, i.e. by the size of their choice set (Jin, Debo, Kremer, & Iravani, 2017). Inherent unto the theory of bounded rationality is the insight that a broader available choice set increases complexity of the choice task and impedes the search for an optimal solution (Simon, 1962). In the study of actual choice behavior, a number of experimental studies have found that the size of the choice set impacts decision makers’ choice behavior (e.g. Iyengar & Lepper, 2000). First, it matters when it comes in the form of additional but irrelevant alternatives where it has been found to change the probability of choosing among the original options (Ariely, 2008). Secondly, it has been found to lead to an aversion to make any (consumption) choice at all (Iyengar & Lepper, 2000). These findings have been directly linked to the inability of decision makers to process information about the available choices (Hauser & Wernerfelt, 1990), i.e. they face greater decision costs for increased “consideration sets” (Hauser & Wernerfelt, 1990: 393). Likewise, we expect higher decision costs and less informational value for peer performance information for a broad choice set in our context. Consider for instance the case of inferring the maximum possible performance by observing the best peer. If the choice set is narrow, i.e. few alternatives are available to the focal unit, such information helps to cut short the learning process. This follows from the fact that there is a high chance of actually finding the best alternative which would then be identified as such by virtue of peer performance information. If, however, the set of choices is broad, i.e. many alternatives are available to the focal unit, such information has less value because chances of actually finding the best alternative are low. The greater the haystack, the less likely it is to find the proverbial needle, i.e. a value above the peer performance derived performance target. This
effect should be less pronounced for the average peer performance information as it is more likely to find any above average alternative than the best paying alternative in a large number of alternatives. Hence, we propose

_Hypothesis 2a. For a broad choice set, the positive effect of average peer performance information on performance is weaker than for a narrow choice set._

_Hypothesis 2b. For a broad choice set, there is no positive performance effect of best peer’s performance information._

**EXPERIMENTAL DESIGN**

**Experimental Framing**

In our experiments, we focus on the question of how the presence of (different types of) peer performance information affects search behavior and, in turn, decision performance.

The participants in our experiments completed a simple search task in which they were asked to repeatedly choose between a number of alternatives (of initially unknown value). On a very abstract level, they were faced with the choice between exploring a new alternative of unknown value or exploiting a known alternative. We narrowed down the actual choice participants had to made between choosing “exploit” or “explore” to avoid memory problems and confusion around the payoffs of a number of lined up alternatives. This task resembles a simple stationary n-armed bandit model without noise in the feedback (Sutton & Barto, 1998).

The experiment was framed as a managerial decision making problem in which participants had to choose among five different alternatives (see figure 1). These different alternatives were associated with (initially unknown) different payoffs. Only by choosing an
alternative, its payoff was revealed. Concretely, the 5 payoffs used in our experimental task are drawn from a uniform distribution.

Optimal Stopping Behavior

It is worth contrasting our findings with the optimal behavior in the task. To this end, we simulated agents randomly exploring $X$ number of times and then exploiting the best found alternative. This was done for a large number of agents (10,000,000). The average performance of that for each optional stopping points $X$ are depicted in the black line in figure 2. As can be seen it is optimal to explore 2 or 3 times and then exploit the best found alternative for the remainder of the task.

As we theorized before, peer performance information should now impact the optimal stopping point by providing information on when to stop exploring; information that would have to be otherwise gained through search. In figure 2, we see a depiction of the theoretical value of peer performance information. Consider first the average peer performance information. The agent in the simulation utilizes this information by stopping to explore at stopping point $X$ if an above average solution has been found till then. If no above average
solution has been found, the agent continues to explore until he finds an above average solution. As an be seen in figure 2, this is particularly helpful if the agent had her mind set on stopping after 1 or 2 rounds of exploration. Consider next the case of the best peer’s performance information. Here, the agent makes use of the information by stopping to explore after X rounds unless she finds the best possible solution earlier. As becomes obvious in figure 2, this type of information becomes all the more valuable the later the agent would have stopped exploring otherwise. Lastly, consider the worst peer’s performance information. In this case, the agent explores for X rounds before turning to exploiting the best best found solution unless she would have otherwise exploited only one time and recognizes her initial choice is the worst. Then, she explores for an additional round. As expected, this type of information only improves performance on average for the decision makers set on a course to over-exploitation.

**Experimental Setup**

*Incentives.* The payoffs were given in an experimental currency, which was translated to a payment in cents at the end of the experiment. We provided the payoffs in this experimental currency to prevent participants from learning about the true payoff distribution. This was important to not allow for inferences as to, for instance, how far the maximum payoff was afar from the average payoff. This translation was made by rank of the profit of a strategy compared with the other strategies’ profits.

Throughout the task participants saw the number of alternative they had explored and how many were still unexplored as well as their current and past profits. We constantly provided this performance history to avoid testing the participants’ memory instead of their genuine choice behavior. Every participant went through only one pass of 4 periods followed by
some demographic questions as well as questions on the understanding of the task. In addition, an attention check was part of the experiment where participants were asked to click a specific alternative to prevent random clicking. Detailed instructions including questions on the understanding thereof were also provided before the experimental task started.

As a baseline payment, all participants received 0.05 US dollars. Those answering additional questions on their decision-making approach earned another 0.10 US dollars. In addition to that, a bonus of a maximum of 10 cents was paid based on their performance in the task.

**Manipulation.** The central manipulation was the peer performance information that was provided. Prior research has identified that decision makers pay attention to different types of peer performance information. Both on the industry level and within organizations, actors have been known to consider the best peer’s performance (Boyle & Shapira, 2012; Larkin, Pierce, & Gino, 2012). Another frequently considered standard of comparison is the average of peer performance, be it in the form of the industry average (Bromiley, 1991; Fliegenbaum & Thomas, 1990; Lant et al., 1992) or internally as the average performance of similar others within the same organization (Earley & Erez, 1991; Locke & Latham, 1990). Occasionally, also the worst peer performance is the focus of attention either to learn from failures of similar others (Maslach et al., 2018) or because no other standard of comparison is available for instance in a duopoly (Lubatkin, Florin, & Lane, 2001). For a more concrete example, consider a sales representative. She has to choose one approach every time she pitches to a potential customer. She learns about the payoff of her strategy only after the fact and faces opportunity costs of becoming a “master of none” when exploring too many approaches while she faces
costs of foregoing a better approach when exploring too little. As per our manipulation she is provided with a ranking of her peers including their sales performances. Meanwhile, she does not observe her peers’ approaches to customers.

In the experiment, the peer information came in the form of a consulting study which stated that peers had in the past a specific average or worst or best performance in the same task. Every participants in an in between subjects design went through only one treatment of either no information, worst peer performance information, average peer performance information or best peer performance information. Each of these conditions existed for the case of a narrow (5 alternatives) and broad (100 alternatives) choice set. Every participant took part in only one treatment to prevent any learning effect between tasks. For simplicity and comparability the payoff values were the same for every participant. After the task a manipulation check was built in to check if participants had remembered the peer information. The central outcome variable was performance in the search task, which was determined by how many alternatives were being explored.

**Respondents.** Participants were recruited the participants on Amazon MTurk. All different peer performance treatments included, 1,471 subjects completed the experiment. 61.8% of the participants were women, the average age was 36.9 years and 27.4% claimed to hold a managerial or supervisory position at their workplace. Participation was restricted to the United States to avoid language difficulties. On average, participants completed the experiment in 5 minutes and 44 seconds and spend 14 seconds on each individual choice. As before, those who did not spend enough time on the instruction pages were excluded from the sample and all subjects were randomly assigned to one of the 8 peer performance treatments
(no information, worst peer performance, average peer performance, best peer performance; each for a narrow and broad choice set).

RESULTS

The experiment was devised to evaluate if and when peer performance information helps decision makers in a simple search task. Specifically, we tested whether peer performance information helps our participants when facing a narrow (10 alternatives) vs. broad choice set (100 alternatives). Theoretically, this type of peer performance information helps decision makers to better manage the switch from exploration to exploitation. Take, for example, the case that the decision maker’s first choice has a payoff equal to the maximum payoff. Knowing that it is the maximum available payoff is clearly helpful, because the decision maker can stop exploring and start exploiting this choice. Without this information, the optimal search strategy is to continue exploring two more. Obviously, the value of the information on what constitutes the maximum available payoff decreases in the number of alternatives. This is so because in a situation where there are a limited number of choices, but also a limited number of alternatives to choose from, the potentially possible displayed maximum is also practically attainable. When, however, the number of alternatives is scaled up, the likelihood of ever coming across the potentially possible maximum goes down.

Similarly, the lowest and average available payoffs should inform the decision maker on when to switch from exploration to exploitation. Consider first the case of knowing the worst possible payoff. Though it informs those who come across the worst alternative to keep exploring, it does not inform decision makers on when exactly to switch from exploration to
exploitation. Peer performance information in the form of the average of available payoffs, on the other hand, might be more useful. Consider the case where a decision maker comes across an alternative that is better than average. In the absence of peer performance information, she would need to sample at least half of the available alternatives to be sure the first choice is valued above the average, while paying significant opportunity costs in the process. Having average peer performance information thus reduces opportunity costs of search. As in the first experiment, we theorized that the positive effect of peer performance information decreases in the presence of more alternatives. This decreasing effect, however, should be weaker for the average peer performance information as the probability to find an above average alternative is still high with many alternatives. Meanwhile, coming across the minimum or maximum of payoffs becomes very unlikely.

**Not all peer performance information is created equal**

In Figure 3, we observe the respective performance effects of peer performance information in the form of the best peer’s performance along with the average and worst peer performance information. Performance is depicted as the average payoff participants received. We normalize the performance effect by subtracting the corresponding performance in the absence of any peer performance information. Positive values imply that peer performance information led to better decisions; negative values imply that peer performance information led to worse decisions.

We find that the greatest benefit compared to having no information comes from having the average peer performance information (MD = 0.65; p = 2.186e-05), followed by
having the best peer performance information (MD = 0.62; p = 0.0001507) and finally, the worst peer performance information (MD = 0.37; p = 0.01741). We therefore find support for hypothesis 1a and 1b. However, contrary to what we theorized in hypothesis 1c, we do find an albeit small positive performance effect worst peer performance information.

These findings suggest that different peer performance information should not be treated equally. In particular, the decision to provide average peer performance or best peer performance information to decision makers has vastly different performance implications. This same caution seems unwarranted, however, if the worst peer’s performance is provided.

Peer performance information has a negative performance effect for broad choice sets

The results fundamentally change when participants face a large number of alternatives, i.e. when the set of choices increased. While for the worst and average information peer performance advantages become insignificant, the effect turns significantly negative for the best peer information (MD = -0.39; p = 0.009957). When the value of peer performance information under a situation of limited choice is directly compared to the scenario of having many alternatives to choose from, we observe that the best peer information features the greatest loss of value (MD = -1.02; p = 3.758e-10), followed by the average information (MD = -0.64; p = 0.001596) while the loss in value for the worst peer value remains
insignificant (MD = -0.26; p = 0.2054). These results are broadly in line with what we theorized earlier, as the value to peer performance information goes down in the number of alternatives, while over-exploration is only triggered for being tempted by an unattainable maximum. We can therefore confirm both hypotheses 2a and 2b. While the positive performance effect for the average peer performance information did not disappear entirely, it remains puzzling why it did not retain more of its value as we theorized that it should remain valuable under conditions of a broad choice set. We will explore this puzzle later in the result section. In Figure 4, we focus on the performance effect of best peer performance information specifically in settings with a narrow search scope (left bar) and a broad search scope (right bar).

Best peer performance information helps decision makers to make better choices if the set of alternatives is small, i.e. for a narrow choice set. However, if they face a large set of alternatives, i.e. for a broad choice set, best peer performance information becomes a liability - our participants would have been better off without any peer performance information. In hypothesis 2b, we proposed that peer performance information would yield no performance benefits when the choice set is broad. While we do find the reduced value of best peer performance information for broad choice sets, the finding also suggest that the value of peer performance information can even turn negative.
The reason why information on the best peer’s performance turns into a liability for broad choice sets lies in the fact that the information is used ineffectively. Such information helps decision makers choosing between a few alternatives because the maximum can be reached. When there is a large number of alternatives, however, the best peer’s performance is no longer informative about the potential maximum our focal decision maker could reach. However, our participants explore as though they could reach their potential maximum performance as reflected in the best peer’s performance information, when it is very unlikely to reach within the 4 periods of the task. This fallacy is reflected in a higher level of exploration for participants in the best peer treatment when facing a broad choice set compared with their counterparts facing a narrow choice set as can be seen in figure 5.

To confirm that participants were indeed exploring to find the maximum at all costs, we also computed the likelihood that a participant in the best peer condition explores throughout the entire task for the differently sized choice sets. As it turns out, participants facing a broad choice set (large number of alternatives) were twice as likely to never stop searching at all (figure 6).
To illustrate the implications of this finding, consider our initial example of an entrepreneur for example a restaurateur. She has to initially choose from potentially millions of different food combinations to offer on the menu. By being focussed on the most successful restaurant in town, she might try menu after menu without ever reaching her best peer's performance. All the while, she would likely try many menus that are in fact inferior to a menu she has already tried early on.

**Peer performance information is not used properly**

So far, we have established that peer performance information is not always beneficial and might even sometimes become detrimental. As our analysis suggests, even in cases where we expect peer performance information to be useful, we found that this positive value of particularly average peer performance information was not fully realized. We are not the first to point out that social comparison information is not always taken into account in an optimal way. As Johnson and Lammers (2012) point out that feeling powerful or powerless makes decision makers either consider or disregard peer performance information. Social situations necessary for such emotions to influence decision making, though, are absent from our experimental task. Hence, we ask in the following: What in the absence of social hierarchy drives the extent to which peer performance information is utilized? In Figure 7 we compare the normalized performance from the participants of our experiments with a simulation experiment. In this simulation, we assume that decision makers would use the given peer performance information in the simplest way. Without information the simulated agent chooses between exploration and
exploitation at random. When the worst peer’s performance information is present, she avoids the worst alternative. When provided with the best peer’s performance information, and also finds the best alternative, she always exploits. When knowing about the average peer performance information, she will only exploit an above average alternative. As can be seen, the performance difference is particularly pronounced for observing average peer performance, less pronounced for the best peer information and virtually non-existent for the worst information.

This underutilisation of average peer performance information appears to be due to the fact that participants did not take the average peer performance as a signal to switch from exploration to exploitation. To be precise, 45% of participant did not stop exploring upon reaching the performance target of the average possible payoff. The reason for that behavior is likely due to the ambiguity of the average information; while reaching the maximum is a clear signal that the current profit is as good as it gets, more risk seeking individuals might be inclined to search for an even better solution when finding an alternative that is just above average.

This finding implies that average peer performance information, if used as a performance target, can increase performance significantly, but is often not used as such because of its behavioral ambiguity.

Not all peer performance information increases search
A common assumption in the behavioral theory of the firm is that comparisons with better performing others increase search and exploration (Cyert & March, 1963; Greve, 1998). As argued, a performance shortfall relative to social aspiration levels is indicative of a mismatch between the firm and its environment (Mone, McKinley, & Barker, 1998). Search is then initiated to find solutions to the firm’s problems. In a more abstract way, one could say that a firm recognizes it is not exploiting a sufficiently good alternative and needs to explore to collect information on what other alternatives would be available. Following this logic, we maintain that a performance deficiency relative to similar others not only triggers this problemistic search, but also informs decision makers on how long to search for. This intuition suggests that peer performance information can not only increase search, but can also shorten search by giving information on when a sufficient solution has been found. In the following, we analyze when peer performance information increases and when it decreases search. In figure 8, we look at the normalized levels of exploration under the 3 different types of peer performance information when the choice set is narrow (few alternatives available). It is clear to see that exploration is only increased for the best peer typed information while having the average or worst peer performance available actually seems to curb explorative tendencies. Both worst (MD = -0.21; p = 0.04285) and average peer performance information (MD = -0.26; p = 0.01374) lead to significantly lower levels of exploration when compared to the best peer information.

These results are line with our expectations about the value of peer performance information. Because it is unlikely to come across the best alternative early on, participants keep searching longer in the presence of best peer performance information. Average
information, however, is likely to shorten search as participants will know that they have
discovered an above average alternative earlier than without peer information.

DISCUSSION
In the present paper we proposed that peer performance information helps decision makers by
informing them when to engage in search. For the case of narrow choice sets (i.e. a small set of
available alternatives), our results confirm this intuition and show that participants provided with
peer performance information experience a higher performance due to adjusted levels of
exploration. We also find, however, that peer performance information in the form of the best
peer’s performance turns into a liability when available alternatives are legion, i.e. the choice set
is broad. This effect is due to the fact that knowing the best peer’s performance causes
participants to keep exploring when the chances of coming across an alternative that yields the
same as the observed performance is in fact very low. What is more, we observe that peer
performance information is not created equal. We find that while the best peer performance
information can turn into a liability, information on the average peer performance never does.
Further, even though knowing the worst peer’s performance may help, it yields smaller
performance benefits than best and average typed information.

CONTRIBUTIONS
We make several contributions to the literature on peer performance within and in between organizations. Given that we wanted to exclude task effort and focus on the actual choice problem in search, an experiment was proper for this type of analysis because it facilitates manipulations of peer performance information while holding all other factors constant (Sterman, 1987). In addition, experimental research has been established as the prime standard to study the foundations of behavioral strategy (Powell, Lovallo, & Fox, 2011) as well as the behavioral theory of the firm (Cyert, March, & Starbuck, 1961). Conducting the experiments online also allowed us to demonstrate our findings with a heterogeneous sample that has been shown to be more representative than a laboratory student sample (Berinsky, Huber, & Lenz, 2012; Paolacci, Chandler, & Ipeirotis, 2010). It also offers an easier way to replicate our results inexpensively (Bettis, Helfat, & Shaver, 2016).

This research advances the literature associated with the behavioral theory of the firm (Cyert & March, 1963) in a threefold way. First, our results cast doubt on the generality of positive performance effects of providing peer performance information, as maintained by scholars researching goal setting (Locke & Latham, 1990; Smith et al., 1990) as well as management practitioners (Cappelli & Tavis, 2016; Goler et al., 2016; Hope & Fraser, 2003). We instead contend that particularly under broad choice sets, peer performance information can become useless or even detrimental to performance. This insight is increasingly important as organizations operate on a global scale facing a dramatically increased choice set (Levitt, 1983). Second, we contribute to an understanding of consequences of different kinds of peer performance information for search behavior. While scholars have looked at differences in risk taking when anchoring on distinct social aspirations (Boyle & Shapira, 2012; Greve, 1998;
Moliterno, Beck, Beckman, & Meyer, 2014), we consider how decision makers balance exploration and exploitation. Specifically, we demonstrate that a performance shortfall relative to social aspirations does not necessarily induce more exploration. We find that, since the information on peer performance determines how long search is continued, performance consequences differ for different kinds of peer performance information. Lastly, our findings add to the conversation of how actual decision makers differ in their search behavior from their homo economicus counterpart. Prior experimental work has found that decision makers faced with a simple search task follow optional rather than optimal stopping rules (Billinger et al., 2013; Rapoport & Tversky, 1970; Shapira & Venezia, 1981). We complement this research by maintaining that peer performance information impacts the choice of an optional stopping rule.

LIMITATIONS

Critics of our experimental approach will argue that our findings might not hold in actual organizational contexts. While we believe that there is some external validity to our findings, the approach is certainly more geared towards establishing the mechanisms through which peer performance information hurts or helps performance. Our setting has, however, been proven to be a valid abstraction of many real organizational decision making scenarios (Aggarwal, Siggelkow, & Singh, 2011; Cappelli & Hamori, 2013; Puranam & Swamy, 2016).

While the decision scenario in our experimental task is a simplified version of reality, the way in which managers perceive the decisions they face is can be depicted in a dramatically simplified mental model as well (Gavetti & Levinthal, 2000; Halford et al., 1994; Kelley, 1973).
We also do not claim to present a task that is a valid abstraction for all search tasks in real organizational life. Our experiment does not feature intercorrelated payoffs between alternatives; a situation that can be found for instance when a new region is explored as a sales market and neighboring regions’ profitabilities are highly correlated. For these cases a landscape model would be the better abstraction (e.g. Billinger et al., 2013; Levinthal, 1997). Likewise we do not model situations where payoffs are dynamically changing over time, which could be better accounted for with a restless bandit model (Loch & Kavadias, 2002).

What is more, we deliberately excluded an effort component from our experimental task to focus on the choice problem. However, increased effort might partially offset the negative effect we found of best peer performance on performance when the choice set is broad. Increased effort might make decision makers find solutions faster and thus partly balance the decreased probabilities of success.

Lastly, we cannot fully explain why decision makers over-explore under a broad choice set. The finding is, however, consistent with prior experimental studies (MacLeod & Pingle, 2005). One reasonable explanation for that behavior is that decision makers are insensitive to changes in probabilities and more focused on the amount of outcomes (March & Shapira, 1987).

CONCLUSION

Peer performance information is often provided in organizational contexts to increase actors’ effort in a given task. It may also yield valuable information in search tasks that allow actors to balance exploration and exploitation efficiently. Further, it may constitute a previously understudied liability in organizational learning by causing over-exploration when choice sets
are broad. However, this negative performance effect of peer performance information may be found in observing some peer information (best peer performance) but not others (average peer performance).
REFERENCES


FIGURE 1

Sample choice screen

Period 1

The current strategy of your company generates profits of $242 million.

Remember that the average profits in your industry are $73.4 million a year.

Do you want to

- exploit this strategy to earn a profit of $242 million
- explore an alternative strategy with an unknown profit

<table>
<thead>
<tr>
<th>Period</th>
<th>Profits (Millions of $)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>?</td>
</tr>
<tr>
<td>2</td>
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<td>3</td>
<td>?</td>
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<td>4</td>
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Note. The first choice screen under the average peer performance information treatment.
FIGURE 2

Theoretical performance when stopping after X rounds of exploration

Note. Performance is generated by letting an agent draw X times from a uniform distribution and then exploit the best found alternative. The best of 5 alternatives 2.5 cents, the second best 2 cents, the third best 1.5 cents, the fourth best 1 cents and the worst pays 0.5 cent. The performance in the figure is the sum of the 5 draws. The performance of 10,000 agents was simulated, depicted here is the average of the 10,000 agents’ performance.
FIGURE 3

Peer Performance Information and Breadth of Choice Set

Note. Pest peer performance information treatment. Performance is normalized (i.e. actual performance minus the average performance in the no information treatment.)
FIGURE 4

Peer Performance Information and Breadth of Choice Set

Note. Search intensity is measured by rounds of exploration. Normalized here means that the average value of search intensity in the no information treatment is subtracted.
FIGURE 5

Share of Participants Never Exploiting

Note: Measure is the percentage of participants that explored 4 out of 4 times.
FIGURE 6
Normalized Performance for All Treatments

Note. Performance is normalized (i.e. actual performance minus the average performance in the no information treatment.)
FIGURE 7

Human Subject versus Simulation Experiment

Note. Measure is the difference between normalized simulated and normalized observed performance in the experiment. Simulated performance is based upon stopping to explore randomly but when peer performance information is present stopping to explore when coming across the best peer’s or the average peer performance, respectively. In the case of the worst peer’s performance, the simulated agent stops exploration randomly but never on the worst peer’s performance.
FIGURE 8
Search Intensity for All Treatments

Note. Search intensity is measured by rounds of exploration. Normalized here means that the average value of search intensity in the no information treatment is subtracted.